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EXAMINER	
JAWORSKI, FRANCIS J	
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3737	

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No. 10/612,555	Applicant(s) HYNYNEN ET AL.	
	Examiner Jaworski Francis J.	Art Unit 3737	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Specification

The disclosure is objected to because of the following informalities:

Page 7 - 8 bridging appears to contain a non-sequitur. For example after " tissue at the " add -- focal region may be accurately computed as a function of the – That is, the passage appears to be describing in overview the computation of elastic modulus E found later on page 11 lines 10 – 24. and page 13 top portion.

Additionally it is unclear what is meant by 'matching measured reflections' on page 10 line 2. No literal impedance matching such as quarter wavelength coupling layers are discussed. This phraseology may refer to a process wherein, given that attenuation within tissue is frequency-dependent (see specification page 11 lines 22 – 24), applicants act to compensate for this (see specification page 15 lines 19 – 27) however this compensation is apparently effected by mnodifying the elasticity/stiffness equation (1) rather than providing some type of nulling offset or match based on measured reflections at 22. Conceivably this may alternatively pertain to adjusting the level of transducer intensity I and consequent force Fo based upon reflections viewed at display 30 such that the displacement echoes in the harmonic band are amplitude matched to the ordinary range of scanline amplitudes for display, or to imaging issues associated with harmonics. (see Rolt et al US5501655 regarding the unpredictability of harmonics in intermodulation product energy levels col. 2 top

and col. 4 lines 15 – 33 and Ishibashi et al regarding equalization – matching –for echo imaging of energy or intensity distribution.)

Appropriate correction or clarification is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1 – 5, 7-12, 14 – 16 are rejected under 35 U.S.C. 102(b) as being anticipated by Grandia et al (US5827204).

Grandia et al teaches a method and system for monitoring the state of a treatment by determining dissolution or thrombosis in the desired treatment region and comprises the steps of and structure for

transmitting first and second frequency energy beams from first and second transducers 18 driven by frequency generator 56 such that they intersect at focal zone 16 and produce cavitation-causing mechanical vibrations at 14 therein (see col. 3 lines 2 – 4, col. 5 lines 41 –49 and Fig. 1),

transmitting low power imaging energy from transmitter-receiver 110 to third source 68b (col. 6 lines 61-67, col. 7 lines 26 - 40 wherein in line 31 “66b” should read -- 68b --)

receiving low power echoes therefrom (see legend 68b in the face figure), and

analyzing the amplitude (level of cavitation –see abstract) as well as frequency (via high and low frequency range hydrophones per col. 7 lines 11 – 20 and high pass pre-amp 112) on monitor 122 by hydrophone 66b aimed at the target region indicated by received signals from third source 68b. in a digital processor 118 to determine dissolution or fragmentation state of the desired target region (Claims 1 – 2, 8 – 9, 15 – 16.

The first and second frequencies simultaneously present in the energy beams exiting each of the plural transducers 18 aimed at target 16 are respectively different from each other. (Claims 3, 10, 14).

The monitoring of cavitation threshold is inherently related to values which reflect the mechanical dissolution state of the desired region. (claims 4, 11).

The fragmentation by cavitation-disruption necessarily accompanies a stiffness/elasticity change in the dissolved tissue. (Claims 5, 12).

The sources 18 provide multi-frequency ultrasound wave 26 and the ultrasound imaging transducer 68b operates in a pulse –echo system 110 and therefore necessarily provides pulsed bursts of its carrier to provide image band ultrasound. (Claim 7).

The cavitation state is in face an index of reduced elasticity (in the sense that boiling softens meat) and the mere act of focusing by nature provides spatial specificity to both the therapeutic and monitoring portions, allowing them to function substantially independent of tissue outside the focal range.

[The Examiner maintains that 'elasticity' meaning relative stiffness or compliance is broader than 'elastic modulus' as per specification page 6 discussion.] (claim 14).

Claims 1 – 6 are rejected under 35 U.S.C. 102(b) as being anticipated by Lin (US6068597).

Lin teaches a method and system for Doppler-based determination of target region mechanical vibrational resonance properties affected by elasticity (col. 2 lines 50 – 56) and comprising steps or structure for:

transmitting first and second energy beams from first and second audio sources 112 driven by frequency generator 124 so as to intersect at tissue location 422 of Fig. 4,

transmitting energy 444 from a third source i.e. ultrasound transducer 114 into region 422,

receiving signals 446 from the desired region 422 due to the third source transmitted energy, and

analyzing all of amplitude (in mean power estimator 730), phase (since quadrature processing preserves phase, see step 1034) and frequency (spectrum processor 136 acting on spectrum buffer 732) of the stepped audio vibrations (col. 5 top) to determine the target region properties. (Claims 1-2, 4-5).

As the audio frequency beams are stepped in the fashion taught on pages 4 – 5 bridging, at different times each of the first and second sources emits frequencies that differ from each other. (Claim 3).

Lin notes in col. 2 that cross-correlation of echo signals which track the induced vibration can be used to obtain displacements from which to calculate elasticity, alternative to Doppler resonance processing (Claim 6). ,

Claims 1-5, 14-15 are rejected under 35 U.S.C. 102(b) as being anticipated by Greenleaf et al (US5903516) and Ehman (US5592085).

The former teaches a method of determining mechanical hardness properties of a target region including the steps and structure for:

Transmitting first and second ultrasound energy beams of differing frequencies (Col. 8 lines 1 – 10) .

Receiving signals on a microphone 44 or Doppler transducer 62 as both second and third source, and

Color analyzing for mechanical hardness in processor 52.

Additionally, Greenleaf et al proposes an alternative vibration analyzer to 44 or 62 in the form of the commonly assigned MRI tissue elastic property measurement system 08/325,834 (col. 10 top) now US5592085 as cited here.

That is, the Greenleaf et al dual frequency system supplants vibration inducer 130 of Ehman and the active third source transmission and reception analysis proceeds along MRI lines particularized to track tissue displacement phase, see col. 2 bottom. Ehman being an incorporation by reference,

Greenleaf et al is anticipatory within the four corners of its teachings. (claims 1 - 3).

Stiffness/elasticity are calculated. See col. 3 lines 26-35 of Ehman. (claims 4-5).

Both the focusing of the first and second sources by Greenleaf et al and the use of spatially specific field gradients as the third source in the incorporated Ehman provide some independence from intervening structure. Greeenleaf et al has structure for generating first and second frequencies . (Claim 14).

The matching of the gradient field to applied stress cycling by the first and second sources is effectively a stress cycling frequency determination. (claim 15).

Claims 1 – 2 are further rejected under 35 U.S.C. 102(b) as being anticipated by Ehman. In col. 15 lines 36-57 Ehman teaches that an ultrasound array may be calibrated for phase by inducing low level in situ tissue vibration prior to high level operation, whereupon:

the method determines a proper mechanical strain level within a desired region by

transmitting energy format least first and second ultrasound transducers of a phased array to a focal target,

transmitting MRI gradient energy into the region,

receiving the energy onto detection coils, and analyzing phase in the stated fashion in order to ensure that the mechanical strain induced by the first

and second sources is properly target-confined before the power level is raised. (Claims 1 – 2). .

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 3, 10 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grandia et al as applied to claims 2 and 9 above, and further in view of Rolt et al (US5501655).

Assuming arguendo that the listed claims demand that different vibration/ultrasound frequencies be present respectively on the different first and second transducers in the exclusive sense, whereas Grandia et al is directed to improving over Rolt et al, see col. 1 line 63 – col. 2 line 7, it would have been nonetheless obvious in view of Rolt et al to provide separate focused ultrasound transducers 14,15 and 16, 17 since Grandia et al allows that transducer 18 may be comprised of separate focused elements. Alternatively stated, Grandia is solving that which makes Rolt undesirable, i.e. by providing common transducer

containment registry and movement control in housing 74 and actuator 50 this allows for Grandia et al to announce that like Rolt et al, separate commonly focused transducers may be used for the high power application.

Claims 1 – 5, 7-12 and 14 – 16 are are rejected under 35 U.S.C. 103(a) as being unpatentable over Greenleaf et al (US5903516) and Ehman (US5592085) further in view of Sato et al (US4566460) and Shimura et al(US4610255).

The former are applied as above however the Ehman incorporation is now viewed as simply an invitation to recover the information from the multi-frequency intersecting-beam first and second source ultrasound transducers by using an imager. Since elsewhere Greenleaf et al liken their technique to non-linear parameter (B/A) techniques, see col. 3 top, although they are silent as to incorporation of ultrasound imaging, it would have been obvious in view of the latter pair to use such an ultrasound imager as opposed to an MRI imager for amplitude –frequency –phase analysis of elastic mechanical properties. Specifically Sato et al use ultrasound first and second sources including array sources providing intersecting beams for both the vibration-inducing and the pulse measurement portions see Figs. 10 - 16, and teach that in addition to amplitude and phase and frequency analysis the system is applicable like Greenleaf et al to elasticity measurements, see col. 2 line 11, and that a variant to pulsed pumping or vibration induction is the variable frequency application of vibration induction, see col. 3 lines 33 – 45. Shimura et al teach that whereas

Sato et al is of through-transmission type, a variant would be the use of a pulse-echo type third source since this enables a single application window to be used.

Claims 1 – 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combined Sarvazyan (US5606971) and Sarvazyan et al (US5810731, CIP of the former) patents.

Sarvazyan is directed inter alia to tissue propagation of an amplitude modulated shear wave-inducing vibration by an ultrasound array with switched receive onto the same array for detection of the strain induced by the disturbance with subsequent Young's modulus and other elasticity calculations. Sarvazyan et al extends the former to use of an active (transmit as well as receive) detection array at the same or at another site from the point of shear wave injection as well as monopolar pulse use for the first and second sources as an option versus amplitude modulation Accordingly one may view the general rejection format as the original Sarvazyan modified by the CIP teaching to make the detection array active or alternatively the improvement Sarvazyan et al modified by the original teaching to use an array as the shear wave-inducing pulse source such that one may point to discrete first and second source elements contributing to the target-focused result.

Specifically, Sarvazyan teaches in Fig. 2 that an ultrasound phased array 1 may include at least first and second source transducers which provide a strain-inducing waveform of a first carrier frequency and a second amplitude modulation frequency and at least a third passive receiving transducer within the

array for receiving signals (see col. 4 lines 35 – 67), for determination of elasticity/Young's modulus and other parameters (col. 5 lines 55 – 57) and including measurement of amplitude and phase as well as frequency tracking (see col. 4 lines 6 – 27). Sarvazyan et al adds thereto the teaching that the ultrasound piezoelements 206 associated with vibration detection may be active elements and commonly or remotely sited. (Claims 1 – 5, 8-12, 14 - 16).

Both references teach cross-correlation of signals, see Sarvazyan col. 5 lines 18 – 32; Sarvazyan et al col. 6 top. (Claims 6, 13, 17-18).

The pulse echoes from 206 would be pulsed-envelope carrier bursts (Claim 7)..

Since the array 1 of Sarvazyan Fig. 2 would typically have over a hundred elements, the first, second, third ultrasound transducers each comprise plural transducers (Claim 19).

Claims 3, 10 and 14 – 19 are further rejected under 35 U.S.C. 103(a) as being unpatentable over Sarvazyan and Sarvazyan et al as applied to claims above, and further in view of Kompfner et al (US4012950) or Greenleaf et al. Whereas the Sarvazyan/Sarvazyan et al patents are silent as to the use of different respective frequencies with different respective transducers, if this narrower interpretation be accorded the wordings in the listed claims, then it would have been obvious in view of Kompfner et al Fig. 4and col. 6 line 57 – col. 7 line 40 to use intermodulation at the tested sight as the vibration-inducing mode since this provides harmonics for active imaging of elastic properties as discussed therein, or in view of Greenleaf et al since this isolates the vibratory

area more completely to the vibrated zone. Otherwise the above arguments concerning the base references apply. (Claims 3, 10, 14-19).

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sarvazyan and Sarvazyan et al, further in view of Kompfner et al or Greenleaf et al as applied to claim 18 above, and further in view of Ishibashi et al (US5984881) or Rolt et al. The former are applied as above.but do not teach the use of odd harmonics in the third or detection source. However it would have been obvious in view of Rolt et al cols. 2 and 4 as previously noted or Ishibashi et al Fig. 8 and col. 15 lines 1 – 7 to image at an odd harmonic since the intensity distribution of an echo of a perturbance effect such as tissue hyperthermia or cavitation would include .components such as the third harmonic. (claim 20).

Claims 1 – 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Greenleaf et al as incorporating Ehman as applied to claims above, and further in view of Sarvazyan and Sarvazyan et al , alone or in the case of claim 20, further in view of Ishibashi et al.or Rolt et al .

Greenleaf et al incorporating Ehman is applied as above, and effectively the Sarvazyan et al set are being substituted analogous to 'Sato and Shimura et al', and are applied as they are discussed immediately above. That is, given the suggestion in Greenleaf et al to actively image as a form of detection as in Ehman, and given the analogy drawn to ultrasound imaging as an active detection modality for elasticity investigations, then alternative to substitution of

the B/A non-linearity implementations (which overlap into viscoelasticity measurement) , the formal tissue elasticity measurement implementation Sarvazyan et al teachings may alternatively be substituted thereinto. (Claims 1 – 19), and Ishibashi et al or Rolt et al are applied against the odd harmonic imaging feature (Claim 20).

Patentability Assessment

The Grandia et al/Rolt rejection poses that since the claims are broadly directed to using intersecting and/or multiple frequency ultrasound source beams to determine tissue properties and regarding claim 14 to determining relative stiffness or compliance, this hyperthermia/cavitation target localizing teaching set is readable against most of the claims.

The Lin based rejection proposes that where the intersecting first and second source energy beams which induce the desired region vibration are not limited to ultrasound (first Claim set 1-8), then vibrational Doppler resonance analysis of elasticity-related tissue characteristics is applicable against some of the claims.

The Greenleaf et al/Ehman rejection poses that where the third source/determining means energy beams are not limited to ultrasound (first and third claim sets 1-8, 14-20), then an MRI tissue-elasticity measuring system is also applicable to certain claims therein

The Ehman rejection alone proposes that a few claims which require neither plural frequency first and second sources nor an ultrasound third source nor particularlized measurements are rejectable based on the use of an MRI imager to calibrate an ultrasound phased array by making it a vibrating source and studying its low-power effect on tissue to be treated.

The Greenleaf et al/Ehman v Sato et al and Shimura et al proposes that due to specific suggestion in Greenleaf et al, a B/A non-linearity ultrasound system may be substituted for Ehman. (In general, Sato et al provides suggestion to determine viscoelasticity and suggests variants of multiple frequency first and second sources delivered by ultrasound transducers along with third source set through-transmission measurement while Shimura et al modifies-improves by using a pulse echo third source/determining means.)

The Sarvazyan/Sarvazyan et al rejection applies teachings of ultrasound focused driver element and active strain sensing array-based measurements of elasticity parameters based upon which the argument the addition of Kompfner et al or Greenleaf et a respectively represent the Examiner's respective core arguments that since localized in situ beat frequency resonance vibration elicitation was known for high resolution elasticity study as an earlier discovery in association with acoustic microscopy(Kompfner et al) and that since the passive hydrophone detection in such beat frequency mechanical tissue property study alluded to by applicants on specification page 3 top was recognized to be supplantable by active (MRI) imaging or by active ultrasound imaging since this was a known B/A technique. (Greenleaf et al).

The Greenleaf et al/Ehman in view of Sarvazyan/Sarvazyan et al rejection proposes that this argument can be 'built' the other way, that is, given the Greenleaf et al invitation to image strain by an active sensor set alternative to a passive hydrophone, then it would have been obvious to do so in a way that was conventional for conventional local strain-inducing measurement systems as in Sarvazyan/Sarvazyan et al which also traded the early passivedetector (film 5) for active sensing set 206..

Built either way, the Examiner's core opposition argument is that beat frequency or localized resonance heterodyning is an obvious adaptation to ultrasound vibration-inducing active strain measurement systems for elasticity determinations in target tissue, and therefore a patentable wording construct is not evident at this juncture..

Any inquiry concerning this communication should be directed to Jaworski Francis J. at telephone number 703-308-3061.

FJJ:fjj

9-17-2004

Francis J. Jaworski
Primary Examiner